CORAL REEFS, MANGROVES, & PARKS



Here's how they're possible in the NSS 'Long Island' concept

Nature Society Singapore has proposed adding natural features like coral reefs and mangroves to the government's Long Island plan for protection against rising seas, along with details on how these suggestions could be implemented.

By **TONY O'DEMPSEY** *and* **JOHN YIP**

Nature Society Singapore (NSS) has prepared a conceptual design for the government's Long Island plan to protect the East Coast area against rising sea levels. The concept includes nature-based solutions like the establishment of artificial coral reefs, intertidal habitats, and mangrove inlets, and maps out in detail the landscape considerations for implementing these suggestions.

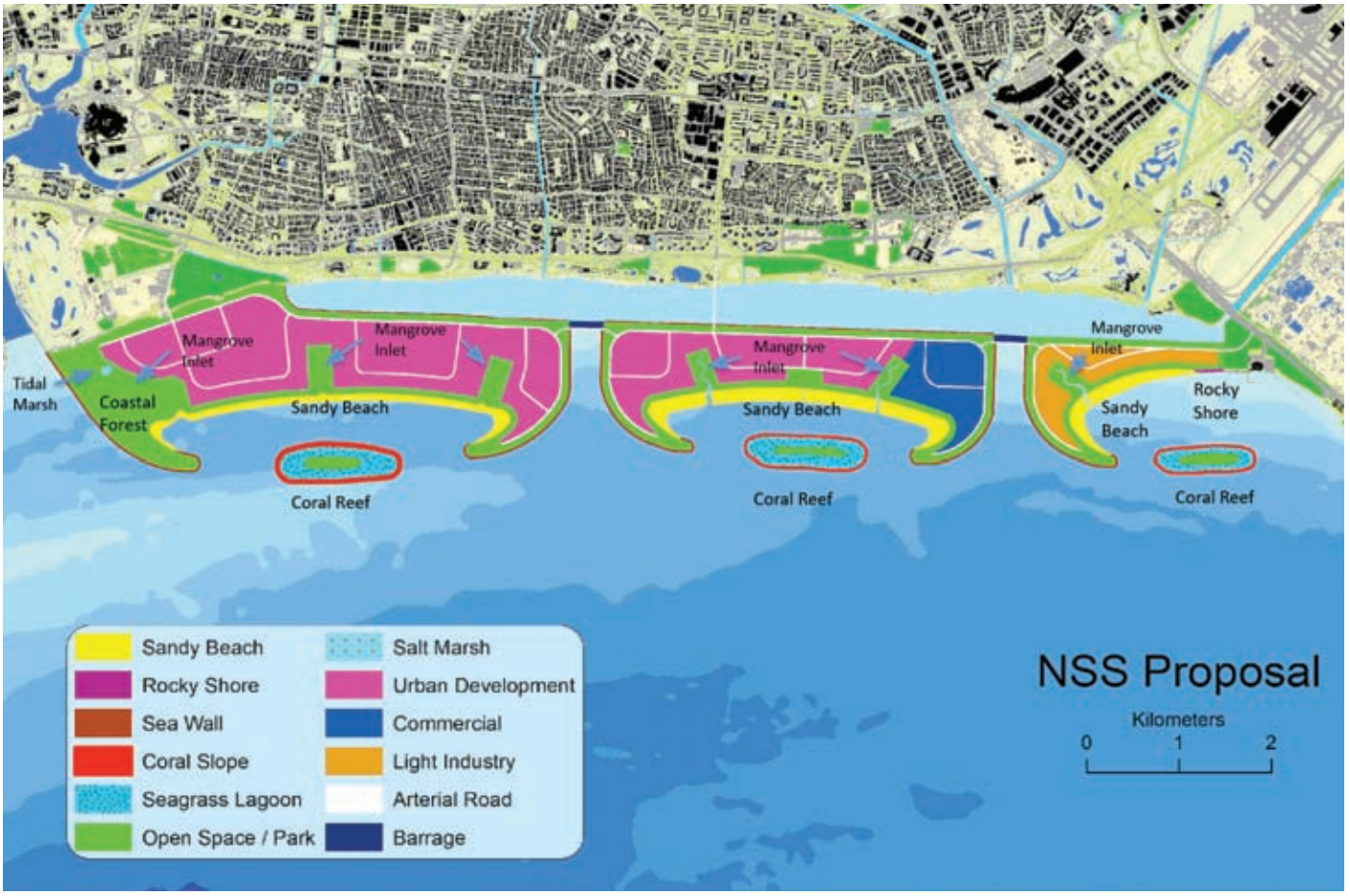
The government's plan, announced in November 2023, involves the reclamation of about 800ha of land along the East Coast. The reclaimed land could take the form of three "long islands" designed to strengthen flood protection in the area, as well as to improve Singapore's water resilience through the creation of a new reservoir.

The NSS concept builds on the government's "seed design", and calls for the development of curved coastal frontage along the south shores of each "long island", as well as the establishment of three artificial coral reefs (see Figure 1). These curved coastlines, along with the coral reefs, will help calm the tidal currents along the outer extent of the long islands, enabling safe conditions for water activities that would not be possible with a long, straight sea wall.

"In general, the Nature Society is always interested in changes to Singapore's landscape, and the Long Island plan represents a major change in both the landscape and the intertidal landscape of the East Coast area. So, we felt that we should make some significant contribution to the process," said NSS member and environmental consultant Tony O'Dempsey.

FIGURE 1

Overall view of the NSS Long Island proposal



- NSS has proposed the development of curved coastal frontage along the south shores of each "long island", forming sandy beaches.
- NSS is also proposing the establishment of an artificial coral reef off the shores of each curved beach.
- The proposal includes the creation of water courses to serve as mangrove inlets in each "long island". These inlets are designed to maintain intertidal habitats through the careful management of elevation and gradients.
- The curved coasts and coral reefs will help calm the tidal currents along the outer extent of the long islands, and bolster the coastal-protection objectives of the Long Island plan.

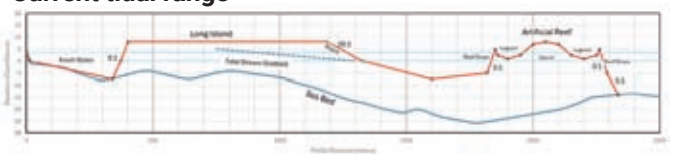
Mr O'Dempsey worked with Mr Lester Tan and Mr Kua Kay Yaw to brainstorm ideas for the NSS Long Island concept. Both Mr Tan and Mr Kua are from the NSS Marine Conservation Group; Mr Tan is the current chair of the group, while Mr Kua is its former chairman.

"We wanted to offer suggestions that could be viable from our point of view," said Mr O'Dempsey. "Take mangroves, for example. A lot of people have called for mangroves to be implemented as part of the Long Island plan, but that's easier said than done. Mangroves are very difficult to set up, with a success rate of only about 30% in many parts of the world.

"So we looked at the idea and decided that we can't have mangroves along the frontage of the proposed 'long islands', because that's not where mangroves would naturally grow. Instead, we've proposed the creation of five 'mangrove inlets' across the development.

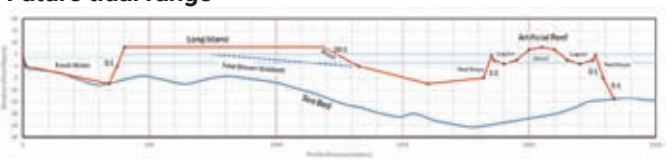
"We wanted to offer suggestions that could be viable from our point of view. Take mangroves, for example. A lot of people have called for mangroves to be implemented as part of the Long Island plan, but that's easier said than done. Mangroves are very difficult to set up, with a success rate of only about 30% in many parts of the world.

Current tidal range



- This is the cross section of the gradients and elevations of the proposed reclamation works (red line), matched against the current tidal range (light blue; the upper line indicates maximum water level at high tide, while the lower line shows the water level at low tide).
- The blue dotted line indicates the proposed gradient of the water courses that will serve as mangrove inlets (see Figure 2 for more information).
- The cross section of the proposed artificial coral reef can be seen on the right side of the diagram (see Figure 3 for more information).

Future tidal range

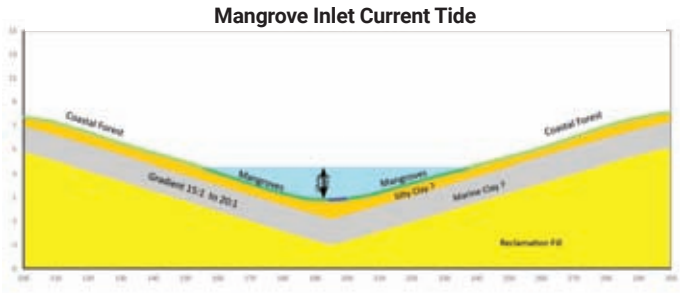


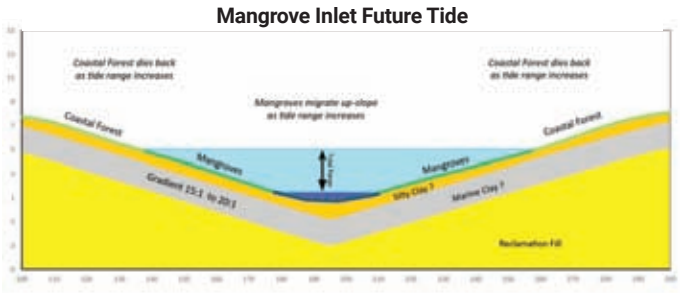
- This is the cross section of the gradients and elevations of the proposed reclamation works, matched against the future tidal range, which is projected to be as much as 1.5m above the current tidal range.
- Crucially, the NSS proposal anticipates the overlap between the current and future tidal ranges in the design of the mangrove inlets and the artificial coral reefs.

FIGURE 2

How the 'mangrove inlets' work

- The proposed mangrove inlets are designed to be wide enough to cope with the anticipated impact of rising tidal ranges.





- More importantly, the banks of the inlets are designed to have a gradient that will allow mangrove trees and their propagules to progressively move upslope in response to rising tidal ranges.
- The NSS proposal also calls for the establishment of coastal forests above the high-water mark at the current tidal range. These coastal-forest habitats will naturally recede as the tidal range increases over time, and will be replaced by the natural establishment of mangroves.

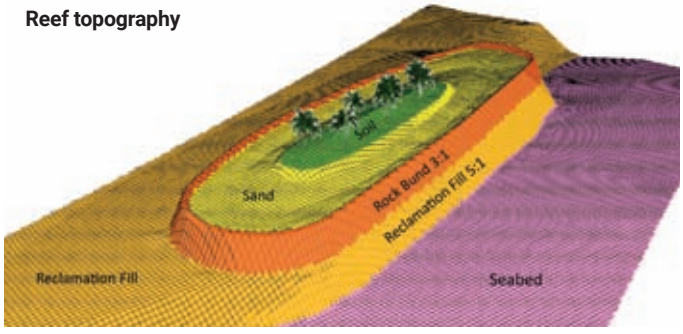
"These would be artificial water courses, and we envision the elevation and gradients of these systems – in effect, the vertical profile of the channel – to be such that they would not only facilitate the establishment of mangroves, but also allow them to progressively move upslope as sea levels rise."

The NSS concept also outlines how the Long Island plan could help reestablish corals. "Our proposal for curved coastal frontages and gentler intertidal slopes creates an opportunity to have artificial reefs," said Mr O'Dempsey. (see Firgure 3)

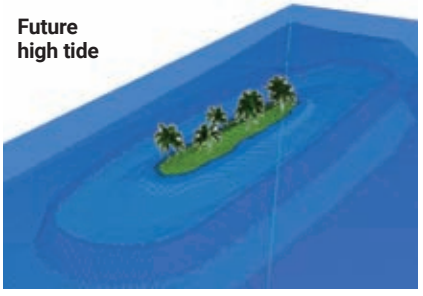
"This can be achieved by reclaiming small islets off the centre of each curved coastline, and adding rocky material on top of the reclaimed soil. The rocky substrate would be able to support coral establishment, and we could end up with a patch reef."

FIGURE 3

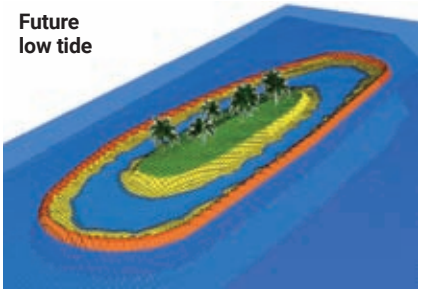
How to establish the artificial coral reefs



- This is the 3D view of the proposed reclamation strategy. It indicates the relative heights of the sub-surface reclamation, that is, the sections of reclaimed soil that will be underwater.
- The NSS proposal calls for a rock bund (dark orange) to be added on top of the reclamation fill (orange).
- The rock bund should consist of rocky substrate that coral spawn can attach to.
- Coral spawn will be carried in naturally by tidal currents, but the manual establishment of corals should also be considered.
- Seagrass may also establish themselves, and this can be further facilitated by direct planting.



- This image shows the extent to which the coral reef will be submerged during future high tides, with only a small strip of land remaining above the high-water mark.



- Conversely, at low tides, the intertidal habitat becomes accessible. The NSS proposal anticipates that some form of public access to the artificial reef and intertidal habitat will be allowed.
- The NSS proposal anticipates that the proposed islets, which will sit above the highest projected tidal levels, could be "greened" and developed into parks or picnic facilities.

Mr O'Dempsey said it is likely that corals will naturally establish themselves on the rocky substrates due to the availability of coral spawn released annually into the tidal currents. However, manual establishment of corals could also be considered, depending on cost and the availability of resources.

The NSS concept for the Long Island plan has already been presented to the authorities. In the meantime, the Urban Redevelopment Authority and its partner agencies have indicated that they remain open to public feedback, with more in-depth engagements to be conducted over the next few years, alongside progress on technical studies.

Mr O'Dempsey readily agreed that further research is needed. The Long Island plan is, after all, a mega project that will take decades to develop, and the stakes – and their associated costs – will be very high. "We don't expect our proposed concept to become the final design. We understand that there is a lot of work yet to be done – more designs and more research – before planners and scientists come in to assess if any of these are feasible."